DEHDASHT PETROCHEMICAL INDUSTRY COMPANY

DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT

Contract No

Thermal general notes/ comments:
1-Since it is not possible to input real tube material in HTRI Ver.6 and this item effect on overall U calculation, so we will check the design with HTRI Ver. 7 and inform vendor to resolve the problems if any.
2-all mechanical consideration shall be consider in your thermal file same as total tube sheet thk. baffles thk. floating head distance ,nozzles accepted preliminary thk.
3-tube passes arrangement shall be added to each report for creating thermal file or can be send the related thermal file for checking.
4-Tube bundle lay out shall be added to each thermal file.
5-By pass sealing device shall be announced based on your tube layout design. (in each items)

Thermal Calculation for Heat Exchangers

PURCHASER'S COMMENT/APPROVAL STATUS	
1	AP: Approved (Released for Manufacturing)
2	AN: Approved With Minor Comments (Fabrication may Proceed)
3	NF: Approved With Comments (Fabrication not Proceed)
4	RJ: Rejected
5	NR: Not be Returned

Date: 12.12.2021 Signature: A.AB

Purchaser: NARGAN

Requisition No.: DPIC98-12-001-000-ME-MR-4150-0001-D1

Item No. (Tag No.): PK-6101

Vendor Doc. No.: DPIC9812-000-VD-1002-ME-CLN-0032-D1

REV.	DATE ISSUE	Purpose of Issue	PREPARED	CHECKED	APPROVED
D1	02-Dec-21	IFA	R.GOUDARZI	DR.A.NEJATI	DR.A.NEJATI
D0	30-Oct-21	IFA	R.GOUDARZI	DR.A.NEJATI	DR.A.NEJATI

TABULATION OF REVISED PAGES

Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
1	x	x			
2	x	x			
3	x	x			
4		x			
5		x			
6		x			
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PURPOSE:

The purpose of this document is to calculate Heat exchangers.

Thermal calculation is done by “ASPEN EXCHANGER DESIGN AND RATING V11”.

ATTACHMENTS:

Thermal calculation sheets for heat exchangers as below:

1- E-6101 (Hexane Cooler)

2- E-PK6101-1A/B (Oil Cooler)

3- E-PK6101-2 (Propylene Condenser)

4- E-PK6101-3 (Economizer)

HTRI

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV D1
Service of Unit	EVAPORATOR	Item No.	E-PK6101-2
Type	BKU	Orientation Horizontal	Connected In 1 Parallel 1 Series
Surf/Unit (Gross/Eff)	478.25 / 467.95 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 478.25 / 467.95 m2

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		HEXANE	
Fluid Quantity, Total	kg/hr	19500.1		748005	
Vapor (In/Out)	wt%	24.0	100.0	0.0	0.0
Liquid	wt%	76.		100.0	100.0
Temperature (In/Out)	C	-23.		-16.00	-20.27
Density	kg/m3	5.7800 V/		703.25	706.94
Viscosity	mPa-s	0.0073 V/		0.4872	0.5147
Specific Heat	kJ/kg-C	1.4050 V/		1.9060	1.8875
Thermal Conductivity	W/m-C	0.0127 V/		0.1310	0.1325
Critical Pressure	bar-G				
Inlet Pressure	bar-G			5.901	
Velocity	m/s				1.96
Pressure Drop, Allow/Calc	bar	0.1(		0.500	0.289
Average Film Coefficient	W/m2-K			2225.28	
Fouling Resistance (min)	m2-K/W			0.000090	

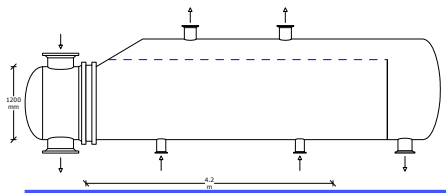
This is normal flowrate of package. It seems that comments on previous revision were confusing. internal package design is by vendor previous design was acceptable and comments can be ignored but this design is not acceptable since flowrate is less than design flowrate.

Heat Exchanged	1687. kW		Overdesign 8.19 %	
Transfer Rate, Service	647.13 W/m2-K	K	Clean 875.07 W/m2-K	

CONSTRUCTION OF ON

Sketch (Bundle/Nozzle Orientation)

			Shell Side	Tube Side
Design Pressure		barG	23.+F.V	23
Design Temperature		C	-45 /125	-45 / 125
No Passes per Shell			1	2
Flow Direction			Upward	Downward
Connections	In	in	2 @ 8	1 @ 18
Size &	Out	in	2 @ 8	1 @ 18
Rating	Liq. Out	in	@	@



Please recheck inlet nozzles location with considering shell side inlet flow states it is recommended to relocated on side instead of bottom.

Tube No. 1740 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 4.200 m	
Tube Type Plain	Material CARBON STEEL	Pa	
Shell ID 1200.00 mm	Kettle ID 1656.09 mm	Pa	
Cross Baffle Type SUPPORT	%Cut (Diam)	Im	
Spacing(c/c) 820.213 mm	Inlet mm	No. of Crosspasses 1	
Rho-V2-Inlet Nozzle 301.62 kg/m-s2	Shell Entrance 189.05	Shell Exit 13.71	kg/m-s2
	Bundle Entrance	Bundle Exit	kg/m-s2
Weight/Shell 17048.3	Filled with Water 27339.3	Bundle 7711.71 kg	

Notes: Supports/baffle space = 4.

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	36.86	Shellside	0.37	A	0.000
Tube	40.40	Tubeside	1.96	B	1.000
Fouling	19.99	Crossflow	0.28	C	0.000
Metal	2.75	Window	0.00	E	0.000
				F	0.000

entrainment ratio shall be reported in your design too.

HTRI

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D1
Service of Unit	OIL COOLER	Item No.	E-PK6101-1A/B
Type	BEM	Orientation Horizontal	Connected In 1 Parallel 1 Series
Surf/Unit (Gross/Eff)	29.80 / 29.24 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 29.80 / 29.24 m2

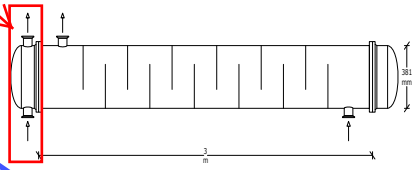
PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		OIL		JACKETED WATER	
Fluid Quantity, Total	kg/hr	12672.1		22549.0	
Vapor (In/Out)	wt%	0.0	0.0	0.0	0.0
Liquid	wt%	100.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	50.00	37.00	
Density	kg/m3	873.29	886.00	993.59	
Viscosity	mPa-s	1.6365	2.1900	0.6914	
Specific Heat	kJ/kg-C	2.0871	1.8530	4.1773	
Thermal Conductivity	W/m-C	0.1500	0.1500	0.6252	0.6352
Critical Pressure	bar-G				
Inlet Pressure	bar-G	20.887		5.901	
Velocity	m/s		0.18		0.64
Pressure Drop, Allow/Calc	bar	0.200	0.024	1.000	0.094
Average Film Coefficient	W/m2-K	607.25		4032.85	
Fouling Resistance (min)	m2-K/W	0.000170		0.000200	

Heat Exchanged	209. kW	MTD (Corrected)	20.1 C	Overdesign	19.15 %
Transfer Rate, Service	356.40 W		4 W/m2-K	Clean	511.55 W/m2-K

CONSTRUCTIO — Sketch (Bundle/Nozzle Orientation)

		Shell Side	Tube Side
Design Pressure		25.000	25.000
Design Tempera		120.00	190.00
No Passes per S		1	4
Flow Direction		Upward	Upward
Connections			1 @ 3
Size &	Out mm	1 @ 3	1 @ 3
Rating	Liq. Out mm	@	@



Tube No.	166 OD 19.050 mm	Thk(Avg)	1.245 mm	Length 3.000 m	Pitch
Tube Type	Plain	Material	C.S.	Pairs seal strips	1
Shell ID	381.000 mm	Kettle ID	mm		
Cross Baffle Type	PERPEND. SINGLE-SEG.	%	Cut (Diam) 30.00		lone
Spacing(c/c)	200.000 mm	Inlet	371.734 mm	No. of Crosspasses	13
Rho-V2-Inlet Nozzle	623.71 kg/m-s2	Shell	Entrance 434.66	Shell Exit	428.43 kg/m-s2
			54.21	Bundle Exit	53.44 kg/m-s2
Weight/Shell	945.72	Fille		Bundle	330.78 kg

Notes:		esistance, %		Velocities, m/s		Flow Fractions	
		Shell	69.93	Shellside	0.18	A	0.074
		Tube	12.11	Tu			0.551
		Fouling	16.99	Cr			0.071
		Metal	0.97	W			0.129
							0.175

CW velocity is too low shall be increased up to 1m/s.

hot fluid to be interred from top.

for carbon steal tubes 2.11 mm shall be considered as min tube thickness with 19.05mm OD.

tube pass arrangement shall be specified

nozzles shall be specified

Please specify real material for checking.

with consider liquid fluid in the shell selected cut is so high please recheck

HEAT EXCHANGER RATING DATA SHEET

This surface is slightly under design.

CUSTOMER	AL	PACKAGE PK-6101	REV. D1
Service of Unit CONDENSER		Item No. E-PK6101-2	
Type BEM	Orientation Horizontal	Connected In 1 Parallel 1 Series	
Surf/Unit (Gross/Eff) 558.37 / 539.62 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 558.37 / 539.62 m2	

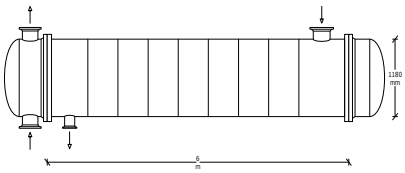
PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		JACKETED WATER	
Fluid Quantity, Total	kg/hr	27623		289299	
Vapor (In/Out)	wt%	100.0	0.0	0.0	0.0
Liquid	wt%	0.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	48.33	37.00	45.00
Density	kg/m3	35.807	467.05	993.59	990.48
Viscosity	mPa-s	0.0112	0.0668	0.6914	0.5960
Specific Heat	kJ/kg-C	2.2660	3.2592	4.1773	4.1774
Thermal Conductivity	W/m-C	0.0267	0.0902	0.6252	0.6352
Critical Pressure	bar-G				
Inlet Pressure	bar-G	18.924		5.901	
Velocity	m/s		0.52		1.00
Pressure Drop, Allow/Calc	bar	0.100	0.016	1.000	0.251
Average Film Coefficient	W/m2-K	1306.59		5496.28	
Fouling Resistance (min)	m2-K/W	0.000200		0.000200	

Heat Exchanged	2682. kW	MTD (Corrected) 9.8 C		Overdesign 32.14 %	
Transfer Rate, Service	505.65 W/m2-K	Calculated 668.18 W/m2-K		Clean 961.77 W/m2-K	

CONSTRUCTION OF ONE SHELL

Sketch (Bundle/Nozzle Orientation)



			Shell Side	Tube Side
Design Pressure		barG	23.000+F.V.	23.000
Design Temperature		C	125.00	190.00
No Passes per Shell			1	4
Flow Direction			Downward	Upward
Connections Size & Rating	In	in	1 @ 14	1 @ 12
	Out	in	1 @ 8	1 @ 12
	Liq. Out	in	@	@

Tube No. 1866 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 5.000 m	Pitch 24.000 mm	Layout 60
Tube Type Plain	Material C.S		Pairs seal strips 1	
Shell ID 1180.00 mm	Kettle ID mm		Passlane Seal Rod I 6	
Cross Baffle Type PARALLEL SINGLE-SEG.	%Cut (Diam) 35.00		Impingement Plate Circular plate	
Spacing(c/c) 550.000 mm	Inlet 853.652 mm		No. of Crosspasses 8	
Rho-V2-Inlet Nozzle 215.87 kg/m-s2	Shell Entrance 264.49		Shell Exit 99.31 kg/m-s2	
	37.59		Bundle Exit 23.96 kg/m-s2	
Weight/Shell 18042.5	Fi		Bundle 9437.36 kg	

Please specify real material for checking.

please recheck baffle selected arrangement

		Resistance, %		Velocities, m/s		Flow Fractions	
		Shell	51.14	Shellside	0.52	A	0.112
		Tube	15.61	Tubeside	1.00	B	0.630
		Fouling	30.53	Crossflow	0.63	C	0.035
		Metal	2.72	Window	0.57	E	0.131
						F	0.092

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D1
Service of Unit	ECONOMIZER	Item No. E-PK6101-3	
Type BEM	Orientation Horizontal	Connected In 1 Parallel 1 Series	
Surf/Unit (Gross/Eff) 115.38 / 113.93 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 115.38 / 113.93 m2	

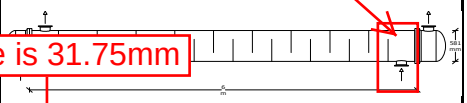
PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		PROPYLENE	
Fluid Quantity, Total	kg/hr	19500.1		7042.97	
Vapor (In/Out)	wt%	0.0	0.0	29.0	100.0
Liquid	wt%	100.0	100.0	71.0	0.0
Temperature (In/Out)	C	48.55	16.00	12.37	15.00
Density	kg/m3	461.40	520.94	17.360 V/L 526.8	17.110
Viscosity	mPa-s	0.0598	0.0894	0.0087 V/L 0.093	0.0087
Specific Heat	kJ/kg-C	3.3321	2.5837	1.6500 V/L 2.578	1.6550
Thermal Conductivity	W/m-C	0.0897	0.1062	0.0162 V/L 0.108	0.0165
Critical Pressure	bar-G				
Inlet Pressure	bar-G	19.007		7.287	
Velocity	m/s		0.21		2.98
Pressure Drop, Allow/Calc	bar	0.200	0.020	0.100	0.038
Average Film Coefficient	W/m2-K	966.96		797.30	
Fouling Resistance (min)	m2-K/W	0.000170		0.000170	

Heat Exchanged	508. kW	MTD (Corrected) 14.2 C	Overdesign 7.70 %	
Transfer Rate, Service	314.69 W/m2-K	Calculated 338.93 W/m2-K	Clean 388.11 W/m2-K	

CONSTRUCTION OF ONE SHELL

			ell Side	Tube Side	/Nozzle Orientation)
Design Pressure			23	23+F.V	
Design Temperature			125	-45/125	
No Passes per Shel			1	3	
Flow Direction			pward	Upward	
Connections Size & Rating	In	in	1 @ 6	1 @ 4	
	Out	in	1 @ 6	1 @ 6	
	Liq. Out	in	@	@	



for carbon steal tubes 2.77 mm shall be considered as min tube thickness with 25.4mm OD.

hot fluid to be interred from top.

routine is 31.75mm

Please specify real material for checking.

please select tube pitch ratio1.25

Tube No. 241	OD 25.400 mm	Thk(Avg) 2.108 mm		Pitch 32.000 mm	Layout 30		
Tube Type Plain		Material LTCS		seal strips 1			
Shell ID 581.000 mm		Kettle ID mm		Passlane Seal Rod No. 0			
Cross Baffle Type PERPEND. SINGLE-SEG.		%Cut (Diam) 28.50		Impingemer			
Spacing(c/c) 300.000 mm		Inlet 412.227 mm		No. of Cross			
Rho-V2-Inlet Nozzle 183.04 kg/m-s2		Shell Entrance 752.43		Shell Exit 666.43 kg/m-s2			
		Bundle Entranc 178.21		Bundle Exit 157.84 kg/m-s2			
Weight/Sh				1929.32 kg			

Dry wall mist flow, film and transition boiling regime are expected for the boiling fluid.
Please resolve the problems.

Notes:				m/s	Flow Fractions	
				0.21	A	0.175
				2.98	B	0.632
	Fouling	12.67	Crossflow	0.29	C	0.051
	Metal	1.31	Window	0.30	E	0.142
					F	0.000